1754

#9 US
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Appl.#:09/525,176
Filing date:03/14/00
Art Unit:1754

Febr. 07, 2002

Completion of IDC in Response to Office Request of 1/29/2002

We complete the IDC by providing within, one copy of the reference titled:

-Environmentally benign hydrocarbon processing applications of single and integrated permreactors, by S. Vasileiadis and Z. Ziaka, published in "Reaction Engineering for Pollution Prevention", Elsevier Science Eds. (2000),

according to the Office request of 1/29/2002 concerning our patent application # 09/525,176.

Sincerely,

Savvas Vasileiadis, *Ph.D. chemical engineering*
Zoe Ziaka-Vasileiadou, *Ph.D. chemical engineering*

PTO/SB92 (08-00)
Approved for use through 10/31/2002. OMB 0651-0031
U. S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Certificate of Mailing under 37 CFR 1.8

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on February 7, 2002.
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Signature

Dr. Savvas Vasileiadis
Typed or printed name of person of signing Certificate

Note: Each paper must have its own certificate of mailing, or this certificate must identify each submitted paper.

DISCLOSURE DOCUMENT

Pat #9

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DISCLOSURE DOCUMENT NO.

414880

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THIS IS NOT A PATENT APPLICATION

PTO-1082 (4/90)

March 2, 1997

Dear Commissioner of Patents & Trademarks,

We are submitting to your office the following disclosure document titled: "Polymer Membrane Reactors for Enhanced Hydrocarbon Conversion & Upgrading" which was submitted as abstract at the 1997 AIChE Annual Meeting to be held at Los Angeles on Nov. 1997.

Within the document we believe that there are novel patentable materials and therefore we are considering it as "invention disclosure document".
This document includes pages 1 through 5.

Sincerely Yours,

Savvas Vassiliades
Zoe D. Ziaka
Ph.D. Chemical Engineering

<HTML><HEAD><TITLE>Submission Acknowledgement</TITLE>
</HEAD><BODY><H4>American Institute of Chemical Engineers 1997 Annual Meeting</H4><HR><H2>Acknowledgement of Successful PTP Submission</H2><HR>
<H3>Email Acknowledgement</H3>
An email acknowledgement has also been sent to the
email address that you provided for the PTP Communicator as well as the
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<H3>The Proposal To Present A Paper</H3>
The following is a copy of your Proposal To Present A Paper that
has been made available for the technical session chairs and administrators
to view.
<HR>
Paper Title:
Polymer Membrane Reactors for Enhanced Hydrocarbon Conversion and Upgrading<HR>By:
Savvas Vassiliades[Speaker]
Zoe D. Ziaka
<HR>Paper Description:
Stiff polymers of high glass transition temperature can act as molecular sieve reactors
for gaseous-hydrocarbons upgrading reactions. Applicable process designs of such modules are investigated.<HR>Abstract Body: (Abstract Body Format: html)
 <HTML>
<BODY>
<P><B>
High glass transition temperature polymer were utilized as reactors in tubular
catalytic hollow fiber configurations for conducting gas-phase catalytic hydrocarbon reforming, oxidation
and water gas shift reactions. Permselectivities of those materials to reaction
products such as H2, CO2, C2H4, CH3OH are considerably high and competitive with regard to those of other currently available porous and dense membrane reactor materials. High packing capacity of the hollow fiber fixed-bed membrane reactors
within the overall reactor module offers large surface areas available for permeation

and product separation.
</B></P>
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<P><B>
The membrane reactors were tested under various modeling operating conditions
of the methane steam reforming, the water-gas shift and the partial oxidation of methane reactions to project suitable process designs for application. Materials and especially polymer, reaction and separation engineering principles
and operations were combined to yield optimum applicable designs for the process
industry. Physical properties of the membrane materials were combined with thermodynamic properties of the molecules involved in permeation process to design long term operation membrane reactors. </B></P>
<HR>
<P><B>
Integrated polymer membrane reactors as well as consecutive placed conventional
reactors with polymer membrane permeators were designed and characterized computationally. The lower temperature operation of these reactors increases the process efficiency together with substantial increase in the catalyst life time.
In overall comparison with conventional reaction-separation systems these reactors
can provide effective cost reduction in process equipment and operations; improved
hydrocarbon conversion, recycling and utilization; enhanced product recovery; and overall calorific value gas for chemical synthesis or energy generation.
</B></P>
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<P><B>
Improved materials and energy transformation makes them highly competitive as environmentally benign chemical processes. Currently available industrial technology for membrane based gas separations makes the new reactor designs imminent candidates for large scale natural gas and hydrocarbon feedstock conversion and upgrading.
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<HR>Paper Key Words:

polymer membrane reactors, hydrocarbon steam reforming, hydrocarbon oxidation, water gas shift, membrane reactor process design
<HR>
Paper URL:

<A HREF="http://www-rcf.usc.edu/~vasileia">
<STRONG>http://www-rcf.usc.edu/~vasileia</STRONG></A><HR>Author Contact Information:
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<HR>Submission Comments:
This is a continuation of our R&D work for designing, modeling and practically
implementing
efficient integration of reaction and separation processes and in particular
permselective reactor-separator designs for natural gas and hydrocarbon
feedstocks
conversion and upgrading.<P>Submitted:Fri Feb 28 23:37:07 1997
Last
Updated:Fri Feb 28 23:37:07 1997
Submitted From: http://www1.che.ufl.edu/
meeting/1997/annual/bin/ptp.cgi/action/author/2?5uKVTBiw
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3.0 (X11; I; SunOS 5.5.1 sun4m)
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This PTP is being submitted to the following sessions:<UL><LI>[20z28]
<A HREF="/meeting/1997/annual/cfp/20z28/">
<STRONG>Developments in Kinetics, Catalysis and Reaction Engineering</
STRONG></A>
<UL>Chair:
Ralph

Pike
Email: <A HREF="mailto:chepik@lsuvm.sncc.lsu.edu">
chepik@lsuvm.sncc.lsu.edu</A>
Phone: 504-388-3428
Fax: 504-388-1476</UL></UL>For further information,
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New PTP</A>
   <LI><A HREF="/meeting/1997/annual/bin/ptp.cgi/next/revise?iZ44D2Mh">Revise
A PTP</A>
    <LI><A HREF="/meeting/1997/annual/bin/ptp.cgi/next/
status?iZ44D2Mh">Check Status of A PTP</A>
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withdraw?iZ44D2Mh">Withdraw A PTP</A>
    <LI><A HREF="/meeting/1997/annual/bin/ptp.cgi/quit?iZ44D2Mh">Quit</A>
    </UL>
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— In addition to the above disclosure described in the abstract we would like to disclose the concept of a "Double wall membrane reactor" in which two permselective wall membrane reactors are placed so that one membrane reactor will be within the other. As an example a double permselective wall tubular reactor can be fabricated so that the inner cylinder will consist of the first permselective material and the outer cylinder will consist of the second permselective material. The membrane materials in the double cylinder can be the same or different so that they can separate the same or different species. Some species (usually in the gas phase) will be separated through the first permselective wall cylinder and out of those some will be separated consequently through the second permselective wall cylinder (outer cylinder).

In a similar fashion multiple wall membrane reactors can be fabricated to act correspondingly for separation of complex mixtures.

These membrane materials can be polymers, ceramics, metals, metallic catalysts such as zeolites or other molecular sieving catalysts or any other suitable permselective materials.

Also they can be composites of those mention materials.

The above described concept can be applied for separation only (e.g., double or multiple wall separators) or for combination of reaction and separation processes (e.g., double or multiple wall reactors & separators placed one within the other).

3/2/97

Sincerely

Sawas Vasiliades

Zoe D. Zlatia